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Injuries in Mechanical Technology Workshops at South African Public Schools

Abstract

Ensuring the safety of learners is paramount in schools, particularly in workshops where hands-on learning takes place. Mechanical Technology teachers bear the responsibility for ensuring learners' safe participation in activities, guided by specific safety management elements that dictate their duty of care and legal obligations. This paper presents findings from a comprehensive investigation conducted in 220 technical schools across South Africa, offering Mechanical Technology as a subject. Combining quantitative and qualitative methods, the investigation aimed to assess the frequency, severity, and management of accidents and injuries occurring in these workshops, while also examining the underlying reasons for such incidents. Results indicated that a significant number of accidents were attributed to unsafe behavior, including failure to wear or correctly use personal protective equipment. Furthermore, the study revealed a notable lack of awareness among participating teachers regarding injury reporting procedures and record-keeping practices. In response to these findings, it is recommended that Mechanical Technology teachers enhance their understanding of their legal obligations and responsibilities concerning learner safety. This entails strict adherence to safety policies and regulations to ensure a secure environment for all learners involved in workshop activities. Moreover, school governing bodies are urged to fulfill their legal mandate by developing and implementing effective safety policies for workshop environments. Such policies serve as crucial tools in reducing and preventing injuries, thereby mitigating legal liabilities for the department, teachers, and schools alike.

Keywords: safe school environment, legislation, accidents and incidents, injuries

Introduction and problem statement

Mechanical Technology is a subject taught during the Senior and Further Education and Training (FET) phase, involving substantial practical work conducted in workshops. The Mechanical Technology workshop encompasses three disciplines: fitting and machine work, automotive, and welding and metal work (DBE, 2014, p. 9). These areas pose significant safety risks due to the use of specialised machinery and tools. Summan et al. (2020) highlight the extensive use of machinery and tools in technical workshops, which poses dangers to both teachers and learners. According to them, the nature of workshop activities exposes learners to potential accidents and injuries. Learners have the legal right to receive quality education in a safe school environment, as outlined in Article 24(a) of the constitution (Joubert & Prinsloo, 2008, p. 156). Rutherford (2009, p. 25) clarifies that a "harmful" environment refers to places where learners face risks. To address this, technical schools and workshops are legally required to prioritise learner

safety and eliminate potential risks. School workshops must adhere to stringent safety measures to safeguard the well-being of learners. Despite these precautions, accidents persist, suggesting a failure to properly implement or adhere to these measures (Smit, 2022, p. 1). Ensuring a safe environment conducive to effective teaching and learning is one of the teacher's foremost duties of care (Oosthuizen & Rossouw, 2008, p. 105). Therefore, Mechanical Technology teachers must understand their legal obligations and responsibilities in ensuring the safety of learners within these workshop settings.

State of the art

Safe school environment and equipment vs academic progress

Ensuring a safe school environment, including secure equipment and facilities, is crucial for effective teaching and learning. Squelch (2001, p. 137) emphasises the importance of schools being safe places for both learners and teachers. Squelch (Ibid.) defines a safe school environment as one that is shielded from potential dangers, allowing teachers to carry out their duties safely and learners to engage in learning without risk. Teachers need to be able to conduct their lessons confidently in a secure environment, allowing learners to develop their potential. Machelm (2015, p. 28) highlights that learners who feel threatened or unsafe cannot fully engage academically, which can negatively impact their academic success and intellectual development. Clarke (2012, p. 207) stresses the necessity of using safe equipment and apparatus to ensure quality teaching and learning in workshops. Safe machinery not only facilitates effective teaching but also enables learners to reach their intellectual potential. Clarke (Ibid.) further suggests that safe equipment contributes to a secure workshop environment, which in turn promotes academic progress. A secure school infrastructure fosters better academic outcomes by allowing learners to participate confidently in school activities without fear of injury. Every learner requires a sense of security, as the absence of it can directly impact their learning process.

Legislation

Legislation mandates the provision of a safe school environment. The South African Schools Act 84 of 1996 (RSA, 1996), under Articles 5(5) and 6(2), assigns the responsibility of establishing the safety policy of the school, including the workshop, to the school governing body. De Wet (2016, p. 168) elucidates that governing bodies at the school level are entrusted with specific powers, particularly those related to the safety policies and programs and the operation of the facilities of the respective schools. This includes the creation of a safe workshop environment. De Wet (Ibid.) further suggests that governing bodies, following a thorough examination of national legislative frameworks, can develop school policies to oversee and regulate learner safety.

In line with this, Joubert and Prinsloo (2008, p. 156) emphasise that governing bodies of schools with workshops are obligated to implement effective safety programs and policies under the regulations of the Occupational Health and Safety Act 85 of 1993 (RSA, 1993). Section 8(2) of the Occupational Health and Safety Act 85 of 1993 (Ibid.) also mandates this responsibility for them. According to sub-regulations 2(1)(2)(2a-g) and (3-7) of the Occupational Health and Safety Act 85 of 1993 (Ibid.), the education department and schools are obligated to educate workshop teachers and learners on the proper use, maintenance, and limitations of safety equipment. They must also ensure that

teachers and learners use the provided safety equipment when performing tasks for which it is intended. This implies that technology workshops must adhere to the health and safety standards and measures outlined in this Act. Summan et al. (2020) suggest that the risk of accidents or injuries in workshops and laboratories can increase if comprehensive safety protocols and policies are lacking, outdated, or not properly implemented. They attribute this situation to the failure of management to create, update, or fully implement the necessary protocols or policies. Considering this, learners attending school workshops have the right to receive instruction in a safe and secure environment, free from harm or disadvantage.

Accidents and incidents

Learners are at risk of accidents and incidents while participating in workshop activities. According to the Occupational Health and Safety Act 85 of 1993 (RSA, 1993) an accident is an unplanned event caused by unsafe behaviour or conditions that may result in injury. An injury is considered a consequence of an accident, although accidents can occur without causing harm to anyone.

The Occupational Health and Safety Act 85 of 1993 (Ibid.) defines an incident as an undesirable event that, under slightly different circumstances, could have caused damage to property, loss of production, or harm to personnel, or that did result in such consequences. Incidents encompass accidents as well as near misses, also known as “near-accidents”.

Injuries in South African school workshops

Smit (2022, p. 6) highlights the International Labour Organisation’s estimation that around 2.3 million workers succumb to occupational diseases and accidents annually, with approximately 160 million workers globally experiencing non-fatal accidents in their workplaces. While these statistics may not directly apply to South African schools’ workshops, they still underscore the inherent risks in such environments and the need for adequate protection measures.

Summan et al. (2020) note that school workshops share similarities with industrial settings, where power equipment is prevalent. The layout and equipment arrangement in school workshops are often modeled after industrial workshops. This suggests that the safety risks observed in industrial workplaces could also manifest in school workshops. Additionally, Smit (2022, p. 5) highlights the lack of comprehensive incident records kept by the national and provincial education departments, further emphasising the need for improved safety measures and monitoring in school workshops.

A review of the literature revealed a dearth of research specifically focused on learner safety in Mechanical Technology workshops, both in South Africa and internationally. Given the absence of official statistics on injuries in South African school workshops falling under national basic education, previous research findings were consulted to ascertain the occurrence of injuries in public school workshops in South Africa. These studies indicated that a significant number of injuries occur annually in public school workshops, with many schools reporting more than 10 injuries per year. However, the severity of these injuries was not delineated in the available data. Nonetheless, these findings provide compelling evidence that injuries are indeed prevalent in South African school workshops.

Research aim, method and design

Research aim

One of the study's objectives was to assess the type and frequency of injuries caused by fixed machinery in Mechanical Technology workshops at schools.

Research method

For the quantitative research, a structured electronic questionnaire was developed based on themes identified in the literature study. The quantitative study was supplemented with a phenomenological study, during which individual semi-structured interviews served as the data collection method. The questions in the interview schedule were formulated based on the conceptual and theoretical framework.

Population and regional sampling

The target population for the quantitative investigation comprised teachers from technical schools in South Africa who teach Mechanical Technology (N=220). For the qualitative investigation, a selective sample was drawn from experienced Mechanical Technology teachers possessing significant skills and expertise. Individual interviews were conducted with a subset of these participants (N=8).

Ethical aspects

The researcher obtained ethical approval from the university's ethics committee, which oversaw and guided the research process. All ethical guidelines mandated by the ethics committee were strictly adhered to.

Data analysis

Appropriate statistical techniques were selected for analysing and processing the quantitative data, with collaboration from the statistical consultancy service at the relevant university. The qualitative interviews were recorded electronically, and after transcription and analysis by the researcher, various groups, categories, sub-themes, and themes were identified.

Findings

Injuries

The study aimed to determine if learners were injured in the Mechanical workshops. Most respondents (68.13%) reported 1-5 injuries occurring during their teaching careers. 18.13% of respondents reported 6-10 injuries, while only 1.88% indicated 11 or more injuries. Additionally, 11.88% of respondents reported no injuries ever occurring in their workshops.

In the quantitative investigation, only 28.13% of the respondents reported accidents and injuries, while 71.88% indicated that they did not report such incidents. With a follow-up question about whether injuries occurred but were not reported, 82.28% of the respondents stated that they were aware of incidents in workshops that went unreported.

Fixed machinery

The fixed machinery that resulted in the highest number of injuries includes the lathe, amaryl grinder, drilling machine, alternating current welding machine, and gas welding. Among these, 16.98% of learners sustained minor injuries while operating the lathe. Minor injuries typically involve minor scrapes, cuts, and burns that can be treated by the teacher. For injuries sustained at the lathe, 29.56% were classified as more serious, requiring treatment by a qualified individual such as a doctor for stitches, broken bones, etc., while 2.52% of learners suffered very serious injuries, which may involve limb amputation or even death. Additionally, 31.25% of learners were treated for minor injuries caused by the amaryl grinder, while 21.25% suffered more serious injuries. 50% of minor injuries were caused by the AC welding machine, while 38.36% of minor injuries were caused by gas welding.

Portable power tool

The portable power tool machinery that caused the most injuries included the angle cutter, sander, and drill. Among these, 41.25% of learners suffered minor injuries while using the angle cutter. Minor injuries typically involve minor scrapes, cuts, and burns, which can be treated by the teacher. Additionally, 15.63% of injuries caused by the angle cutter were classified as more serious, requiring treatment by a qualified individual such as a doctor for stitches, broken bones, etc. Moreover, 14.47% of learners sustained minor injuries caused using the sander, while 13.84% experienced minor injuries from using the drill. Only 1.88% of learners were involved in a very serious incident where injuries were sustained with portable power tools, which could include limb amputation or even death.

According to worldwide statistics cited in the literature study (Adams, Mitchell & Nortier, 2012, p. 3), portable power tools are responsible for many serious, and even fatal, accidents. The information from respondents indicates that portable power tools are indeed hazardous. Therefore, it is crucial to exercise great care to ensure that learners can use such machinery safely during their teaching sessions, minimising the risk of injury.

Hand tools

The hand tools that caused the most injuries were chopping tools, cutting tools, followed by setting tools. Among these, 52.50% of learners suffered minor injuries with chopping tools, while 33.96% experienced minor injuries with cutting tools. Minor injuries typically involve minor scrapes, cuts, and burns that can be treated by the teacher. Additionally, 10.63% of injuries caused by chopping tools and 10.06% caused by cutting tools were classified as serious injuries, requiring treatment by a qualified individual such as a doctor for stitches, broken bones, etc. Fortunately, no learners suffered very serious injuries, which could involve limb amputation or even death.

Meyer and Van der Westhuizen (2016, p. 74) emphasise that the improper use of hand tools is extremely dangerous and can result in serious injuries. Therefore, learners must be taught good workshop practices to ensure they can safely practice their skills.

Cause of incidents

Most respondents (47.5%) cited failure to follow correct safety measures as the primary cause of most incidents. Other reasons included:

- unsafe acts (44.65%);

- use of non-protective equipment (47.5%);
- ignorance (35%);
- lack of supervision (6.92%);
- uncertainty about the cause (1.89%).

Teachers must take note of these accident causes. By implementing effective safety measures, they can prevent similar incidents and create a safe work environment conducive to effective practical development for learners.

Body parts injured

The body part most frequently injured among learners was the fingers (91.82%), followed by facial injuries (63.92%), and arm and hand injuries (61.01%). In contrast, leg and foot injuries accounted for 13.92%, while chest and stomach injuries were the least common (8.86%).

According to Coleman, Straker and Ciccarelli (2009, p. 267), the implications of these injuries can negatively impact the learning ability of learners. Additionally, the risk of accidents and injuries in work centers can be high if there is a climate of insecurity in the school environment.

Reporting of injuries and record keeping of workshop accidents

Only 25% of the respondents reported accidents and injuries, indicating a concerning lack of reporting, with 71.88% of incidents going unreported. One possible explanation for this low reporting rate is that many workshop teachers may overlook minor injuries when it comes to reporting them. Six respondents reported very serious injuries involving machine tools, while four respondents reported very serious injuries involving portable hand tools.

Register of record keeping

Only 41.88% of respondents indicate the availability of a register for record-keeping. This reporting raises concerns as Section 20(1)-(4) of the Occupational Health and Safety Act 85 of 1993 (RSA, 1993) mandates that the school's health and safety committee must maintain records of accidents and injuries in the school workshops. Regulation 8(1) of the General Administrative Regulations of the Occupational Health and Safety Act 85 of 1993 (Ibid.) further stipulates that a record of all accidents and injuries requiring medical treatment must be retained for a minimum of 3 years.

Reasons for not reporting accidents

A significant majority of respondents (88.61%) cited fear of legal implications as the primary reason for not reporting accidents and injuries. Additionally, 60.13% expressed concerns about facing disciplinary action if injuries were reported, leading them to prefer concealing incidents. Other reasons for not reporting included the burden of administrative processes (55.7%) and fear of tarnishing the school's reputation (55.06%). Overall, most respondents (55.7%) agreed that a combination of these factors contributes to the underreporting of accidents and injuries.

The qualitative investigation revealed that participants were willing to report injuries but faced uncertainty regarding the type of injury to report and the reporting procedure. Many expressed a lack of time to report every minor injury. Over half of the respondents

(56.96%) cited the complex administrative processes surrounding reporting as a barrier to reporting all injuries.

Interestingly, schools with designated individuals or locations for first aid and reporting, such as administration offices or technical secretaries, reported all injuries. In contrast, schools where staff had to handle and report injuries themselves often only treated the injury without reporting it. This suggests that busy educational schedules may prevent staff from reporting all injuries, especially minor ones.

De minimis non curat lex

There is widespread misunderstanding regarding the principle of *de minimis non curat lex*, which states that the law does not concern itself with trifles. This principle does not grant teachers the right to dismiss or minimise minor injuries, nor does it absolve them from reporting such incidents. However, it should provide reassurance, as teachers are not held liable or blamed for minor injuries that fall within this principle.

Minor injuries, such as minor scrapes, cuts, and burns commonly occurring in workshops, are those that can be addressed by the teacher on-site. In the quantitative study, 5.8% of respondents reported learners sustaining minor injuries with specific fixed machinery, while 14.42% reported minor injuries with specific portable power tools. Additionally, 24.32% of respondents reported learners suffering minor injuries with certain hand tools.

Conclusion

The findings of this study underscore the critical importance of ensuring learner safety in Mechanical Technology workshops within South African schools. Despite the legal and ethical obligations to maintain safe learning environments, accidents and injuries persist, posing risks to both learners and teachers. The prevalence of injuries, particularly those caused by fixed machinery, portable power tools, and hand tools, highlights the urgent need for improved safety measures and stricter adherence to existing protocols. The inadequate reporting and record-keeping of workshop accidents further compound these safety concerns, with most incidents going unreported due to various factors such as fear of legal repercussions and cumbersome administrative processes. This underreporting perpetuates a cycle of risk and hinders efforts to address safety issues effectively.

It is evident that comprehensive safety policies and procedures, aligned with legislative requirements, must be implemented and enforced at both the school and departmental levels. This includes providing adequate training on safety practices and ensuring access to first aid facilities and reporting mechanisms. Furthermore, the misconceptions surrounding the principle of *de minimis non curat lex* must be addressed to foster a culture of accountability and transparency regarding all workshop-related incidents, regardless of their perceived severity. Ultimately, prioritising learner safety in Mechanical Technology workshops is not only a legal and ethical imperative but also essential for creating an environment conducive to effective teaching and learning. By addressing the identified challenges and implementing proactive safety measures, schools can mitigate risks and safeguard the well-being of all workshop participants.

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Cite this publication as:

Jurgens, C. (2024): Injuries in Mechanical Technology Workshops at South African Public Schools. In *Education in Developing, Emerging, and Developed Countries: Different Worlds, Common Challenges* (pp. 67-74). BCES Conference Books, Vol. 22. Sofia: Bulgarian Comparative Education Society.